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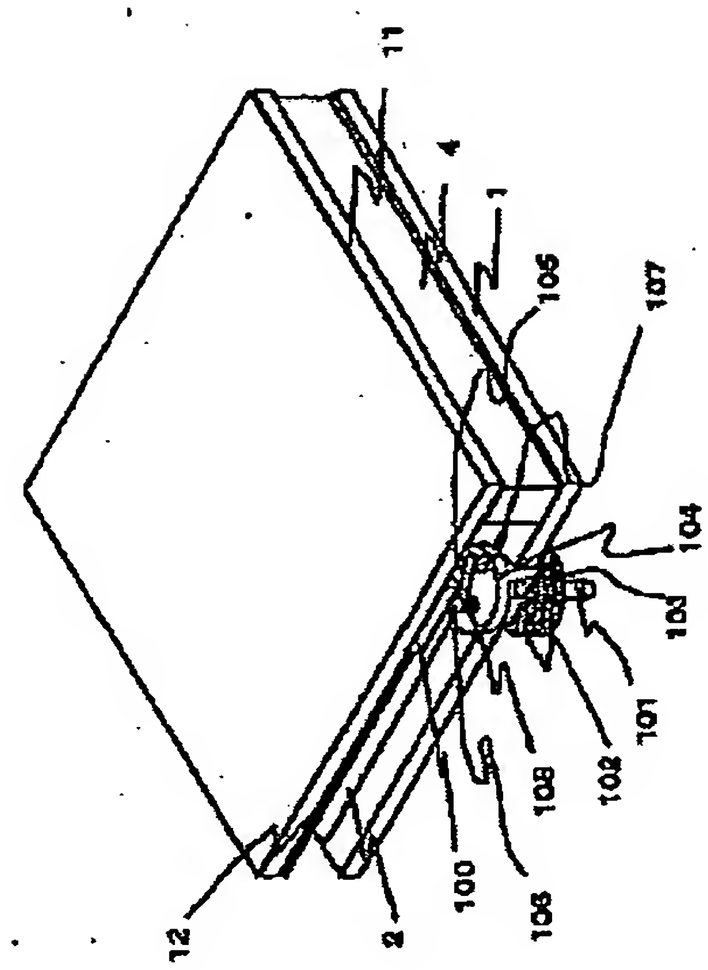
(54) [Title of the Invention] Image Formation Apparatus and Manufacturing/Driving Method of the Same

(57) [Abstract]

[Subject] To provide means for stably and surely supplying a high voltage particularly against a temperature increase and occurrence of an abnormal state due to environmental changes and a high temperature process during manufacturing step, in a vacuum container of an image formation apparatus.

[Means for Solving the Subject] In an image formation apparatus, which has a pair of opposite plain boards; an electron source configured by arranging a plurality of electron emitting elements on at least one of the plain boards in a vacuum container constituted by side surfaces, the vacuum container being positioned between the plain boards; and the image formation member forming an image, and which forms the image by applying a voltage to accelerate electrons between the electron source and the image formation



member, the image formation apparatus is characterized in that an elastic body and elastic body displacement means for displacing the elastic body are provided to a connection means in the vacuum container, the connection means electrically connecting a hole penetrating through the plain board, a high voltage introduction terminal hermetically introduced into the vacuum container through the hole, and a wiring extended from the image formation member. Furthermore, the image formation apparatus is characterized in that the elastic body and the elastic body displacement means are provided in the vacuum container.

[What is claimed is]

[Claim 1] In an image formation apparatus, which has a pair of opposite plain boards; an electron source configured by arranging a plurality of electron emitting elements on at least one of the plain boards ina vacuum container constituted by side surfaces, the vacuum container being positioned between the plain boards; and an image formation member located on the other plain board so as to be opposite to the electron source, the image formation member forming an image by being irradiated with electron beams emitted from the electron source, and which forms the image by applying a voltage to accelerate electrons between the electron source and the image formation member,

the image formation apparatus is characterized in that an elastic body and an elastic body displacement means for displacing the elastic body are provided to a connection means in the vacuum container, the connection means electrically connecting a through-hole penetrating in a plain board, a high voltage introduction terminal hermetically introduced into the vacuum container through the hole and a wiring extended from the image formation member.

[Claim 2] The image formation apparatus according to claim 1, wherein the elastic body and the elastic body displacement means are provided to the interior of the vacuum container.

[Claim 3] The image formation apparatus according to any one of claims 1 and 2, wherein the elastic body displacement means is a magnetic force generating means.

[Claim 4] The image formation apparatus according to any one of claims 1, 2 and 3, wherein a constitution is adopted in which the elastic body

is disposed in the end portion of the high voltage introduction terminal with an elastic body securing member in-between, a magnetic material or a magnet is disposed on a movable portion of the elastic body, and the magnetic material or the magnet is disposed on the elastic body securing member; and the elastic body is displaced by a repulsive force by a magnetic force.

[Claim 5] The image formation apparatus according to any one of claims 1, 2 and 3, wherein a structure is adopted in which the elastic body is disposed in the end portion of the high voltage introduction terminal with the elastic body securing member in-between, the magnetic material or the magnet is disposed on a movable portion of the elastic body, and the magnetic material or the magnet is disposed on a wiring extended from the image formation member; and the elastic body is displaced by the attraction of the magnetic force.

[Claim 6] The image formation apparatus according to claim 1, wherein the elastic body is a cantilever spring formed in at least two laminated layers, and a thermal expansion coefficient of the layer of the cantilever spring on the extended wiring side is larger than that of the other layer.

[Claim 7] The image formation apparatus according to claim 1, wherein the elastic body is provided to the interior of the vacuum container, and the elastic body displacement means for displacing the elastic body is provided to the interior of the vacuum container and to the exterior of the vacuum container respectively.

[Claim 8] The image formation apparatus according to any one of claims 1 and 7, wherein the elastic body displacement means is a magnetic body or a magnet.

[Claim 9] The image formation apparatus according to any one of claims

1, 7 and 8, wherein a structure is adopted in which the magnetic material or the magnet is disposed on the movable portion of the elastic body, and the magnetic body or the magnet is provided to the exterior of the vacuum container in the vicinity of the movable portion.

[Claim 10] A method of manufacturing the image formation apparatus according to any one of claims 1, and 7 through 9, wherein after the vacuum container is formed, the magnet is disposed outside the vacuum container in the vicinity of the elastic body.

[Claim 11] A method of manufacturing the image formation apparatus according to claims 1, and 7 to 9, wherein, after the vacuum container is formed, high density energy light is irradiated to the connecting portion between the extension wiring and a connection member set up between the introduction terminals in a state that the magnet is disposed outside the vacuum container in the vicinity of the elastic body, and then the magnet disposed outside the vacuum container is removed.

[Claim 12] The image formation apparatus according to any one of claim 1s and 7, wherein a magnetic body or a magnet is provided to the top of a movable portion of the elastic body, and an electromagnet is provided to the exterior of the vacuum container in the vicinity of the movable portion.

[Claim 13] The image formation apparatus according to any one of claims 1, 7 and 12, wherein the magnetic material or the magnet is provided to the top of the movable portion of the elastic body, and an electromagnetic force generating/controlling circuit for performing a generation and control of a magnetic force of an electromagnet used for the magnetic material or the magnet and an abnormality detection means sending a control signal to the electromagnetic force

generating/controlling circuit are provided.

[Claim 14] A method of driving the image formation apparatus using the electromagnet for the image formation apparatus according to claim 13, wherein the distance of connection is changed by sending the control signal to the electromagnet from the electromagnetic force generating/controlling circuit based on an output signal of the abnormality detection means.

[Claim 15] The image formation apparatus according to claim 1, wherein a connection means is provided to the interior of the vacuum container, the high voltage introduction terminal is inserted in a movable portion of an elastic spring member, and the elastic spring member is constituted as a part of a vacuum container.

[Claim 16] The image formation apparatus according to any one of claim s 1 and 15, wherein a movable means for moving the elastic spring constituted as a part of the vacuum container is provided to the exterior of the vacuum container.

[Claim 17] The image formation apparatus according to any one of claims 15 or 16, wherein the movable means, a movable means controlling circuit for controlling the movable means and an abnormality detection means of the image formation apparatus sending a control signal to the movable means controlling circuit are provided.

[Claim 18] In the method of driving the image formation apparatus according to claim 17, a method of driving the movable means in which the distance of connection is changed by sending a control signal to the movable portion from the movable means based on an output signal of the abnormality detection means.

[Claim 19] The image formation apparatus according to any one of claims

1 and 15, wherein a structure is adopted which causes the movable portion of the elastic spring of the elastic body to be displaced by a vacuum force.

[Claim 20] A method of manufacturing an image formation apparatus used for the image formation apparatus according to any one of claims 1 and 15, wherein the movable portion of the elastic spring of the elastic body is displaced by a vacuum force.

[Claim 21] The image formation apparatus according to any one of claims 1 through 9, 12 through 13, and 15 through 17, wherein a bump structure is provided to the connection portion between the wiring extended from the image formation member and the elastic body.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Belongs] The present invention relates to a flat panel type electron beam image formation apparatus, and more particularly to an image formation apparatus having excellent reliability, a manufacturing method and a driving method of the mage formation apparatus.

[0002]

[Prior Art] As an image formation apparatus displaying an image by use of electron beam, CRTs having a fluorescent phosphor have been widely used.

[0003] On the other hand, flat panel type display devices using liquid crystal have become in wide use in place of the CRTs. However, because the flat panel type display devices are not of a self light emitting type, they involve problems such as a problem that they have to have a backlight. Development of self light emitting type display devices

has been awaited. As the self light emitting display devices, plasma displays have begun to appear on the market.

[0004] On the other hand, if a plurality of electron emitting elements are arrayed and this assembly is used for the flat panel type image formation apparatus, it is expected that light emission having a grade equal to that of the CRTs can be achieved, and much research and development have been conducted. In Japanese Patent Laid-Open No. Hei 4-163833, for example, a flat panel type electron beam image formation apparatus including a linear hot cathode and a fluorescent phosphor similar to a complex electrode structure and a CRT in the vacuum container thereof is disclosed.

[0005] Generally, as a method to form such a vacuum container, a method has been known in which a rear plate made of glass, having an electron source formed therein, and a face plate made of glass, having an image formation member, are hermetically sealed by a sealer with a frame interposed in-between, has been known. Another method has also been known in which, if the interval between the panels is narrow, both of the plates are hermetically sealed only by a sealer. As the sealer, a low melting point glass material is used, and to soften this material, the sealer undergoes a process to raise its temperature to a high temperature of approximately 400 degrees centigrade.

[0006] In the course of the process, the face and rear plates and various kinds of constituent components including an atmospheric pressure support spacer needed to constitute a vacuum panel, an anode terminal and the like are also exposed to the high temperature. Note that the space between the panels created by the frame and the sealer is formed in the order of hundreds of im to several mm. By use of a vacuumizing

processing, a vacuumizing process is performed for the interior of a sealed panel fabricated after having been undergone these steps, thus forming a vacuum container. Subsequently, after a step of electrically connecting an external driving circuit and an extension wiring formed on the rear plate side, the image formation apparatus is completed.

[0007] In the image formation apparatus using electron beams, which is fabricated in the above described manner, electrons at desired positions are emitted by supplying image signals from an external signal processing circuit through the extension wiring of the rear plate while applying a voltage of hundreds to tens of kilovolts for accelerating the electrons between two glass plates (between the rear plate in which an electron source is formed and a face plate in which the image formation member is formed). Then, the electrons are accelerated by a potential difference between the two glass plates, and cause the image formation member of the face plate to emit light. Thus, an image is obtained.

[0008] Such an image formation apparatus has a structure providing an anode terminal supplying a high voltage to the image formation member. In a structure of the anode terminal described, for example, in Japanese Patent Laid-Open No. Hei 5(1993)-114372, a high voltage supplied from a high voltage generating power supply of an image formation apparatus is supplied from the rear plate side, and is supplied to an image formation member of a face plate through a high voltage cable, an introduction terminal hermetically sealed on the rear plate side and an elastic body connecting the introduction terminal and the image formation member. In addition, in Japanese Patent Laid-Open No. Hei 4(1992)-160741, a method is described in which a tip of an anode terminal and a metal back are adhered by a conductive substance to be electrically connected, and

a high voltage is supplied to an image formation member of a face plate.

[0009]

[Subject to be Solved] However, when the entire structure is baked to a high temperature and is hermetically sealed to form it as a vacuum container as in the case of the above described prior art example, a connection portion of a high voltage extension wiring and a connection terminal is similarly exposed to the high temperature. Accordingly, when an adhesive agent is used in the connection portion, impurities contained in the adhesive are released to contaminate the interior of the vacuum container. The contaminants triggers electrostatic discharges in the course of the high voltage application, and inflict damages to an electron emission element and wirings in the vacuum container. Thus, there is a fear that the defective pixels may be caused.

[0010] On the other hand, a slim-type image formation apparatus that is a principal focus of the present invention is fabricated by disposing two plates of a face plate and a rear plate oppositely. Particularly, in case that a high voltage is introduced from the rear plate side, the face and rear plates need to be connected to cope with errors in panel assembly in the direction of the panel thickness and a deviation of the interval in a hermetic seal high voltage terminal portion. As means for following the deviation of the interval, this image formation apparatus adopts a constitution to absorb the deviation by an elastic body. There is a fear that the elastic body used for the connection may cause a deterioration in elastic property at a high temperature.

[0011] Even if a heat resistant material such stainless steel is used for the elastic body, it is difficult for the heat resistant material to retain the elastic property perfectly. When the elastic property has

changed subtly after assembling, and the connection can no longer be maintained, a function as the image formation apparatus cannot be performed. Consequently, processes performed until the completion of the apparatus come to naught, and it is likely that it causes a yield to be lowered. Moreover, even if the connection state is maintained for some time after assembling, there is a possibility that a temporary disconnection or a complete disconnection is caused due to changes with time, vibrations while transporting the panel, or an earthquake. In this case, if such a disconnection occurs after shipment of the panel as a product, this not only places a burden on consumers, but also recycle by recalling and breaking down the products. This recycle backfires on recycling costs. To avoid occurrence of such situation, assembling of the panel based on full-scale quality control for structural members and a high precision assembly technique are required, and thus a production control cost and a production cost itself are increased.

[0012] The provision of an electron beam image formation apparatus having a high reliability anode connection structure which is suitable for a slim-type structure to solve the above described problems, but which does not require much production control cost is awaited.

[0013] To solve the above described problems, the object of the present invention is to provide means for supplying a high voltage to an extension wiring in a vacuum container stably and surely against a temperature increase and the occurrence of an abnormal situation due to environmental changes and a high temperature process in manufacturing steps when a high voltage is introduced into the vacuum container.

[0014]

[Means for Solving the Subject] In an image formation apparatus, which

has a pair of opposite plain boards; an electron source configured by arranging a plurality of electron emitting elements on at least one of the plain boards in a vacuum container constituted by side surfaces, the vacuum container being positioned between the plain boards; and an image formation member located on the other plain board so as to be opposite to the electron source, the image formation member forming an image by being irradiated with electron beams emitted from the electron source, and which forms the image by applying a voltage to accelerate electrons between the electron source and the image formation member, the image formation apparatus is characterized in that an elastic body and elastic body displacement means for displacing the elastic body are provided to a connection means in the vacuum container, the connection means electrically connecting holes penetrating through the plain boards, a high voltage introduction terminal hermetically introduced into the vacuum container through the holes, and a wiring extended from the image formation member. Furthermore, the image formation apparatus is characterized in that the elastic body and the elastic body displacement means are provided in the vacuum container.

[0015] The elastic body displacement means is a magnetic force generating means, and the magnetic force generating means is a magnetic material or a magnet. The image formation apparatus adopts a structure that as a set-up location of the magnetic force generating means, the elastic body is disposed in an end portion of the high voltage introduction terminal with a securing member for the elastic body in-between, the magnetic material or the magnet is disposed on a movable portion of the elastic body, and the magnetic material or the magnet is disposed on the elastic body solid member. Furthermore, the image formation

apparatus adopts a structure that the elastic body is disposed in an end portion of the high voltage introduction terminal with the elastic body securing member in-between, the magnetic material or the magnet is on a movable portion of the elastic body, and a magnetic material or a magnet is disposed on a wiring extended from the image formation member.

[0016] Furthermore, the image formation apparatus adopts a structure that an elastic body is provided to the interior of a vacuum container, and elastic body displacement means for displacing the elastic body is formed inside the vacuum container and outside the vacuum container.

[0017] With such structures, the magnetic material or the magnet is disposed on the movable portion of the elastic body, and the magnetic material or the magnet is disposed outside the vacuum container in the vicinity of the movable portion of the elastic body. Furthermore, the present invention provides a manufacturing method in which, after the vacuum container is formed, the magnet is disposed outside the vacuum container in the vicinity of the elastic body, thus forming the image formation apparatus.

[0018] Furthermore, after the vacuum container is formed, high density energy light is irradiated to the connecting member disposed between the extension wiring and a connection member set up between the introduction terminals in a state that the magnet is disposed outside the vacuum container in the vicinity of the elastic body. Then, the magnet disposed outside the vacuum container is removed. The present invention provides a manufacturing method of the image formation apparatus manufactured in the above described manner.

[0019] Moreover, in the present invention, a structure is provided in

which a magnetic material or a magnet is provided to the top of a movable portion of the elastic body, and an electromagnet is provided to the exterior of the vacuum container in the vicinity of the movable portion. An electromagnetic force generating/controlling circuit for generating and controlling magnetic force of the electromagnet and abnormality detection means of the image formation apparatus, which sends a control signal to the electromagnetic force generating/controlling circuit, are provided. Furthermore, the present invention provides a driving method of the electromagnet, in which a distance of the connection is changed by sending a control signal to the electromagnet from the electromagnetic force generating/controlling circuit based on an output signal of the abnormality detection means.

[0020] Furthermore, in the present invention, the high voltage introduction terminal is inserted in a movable portion of an elastic spring member, and the elastic spring member is constituted as a part of the vacuum container. Movable means for moving the elastic spring member constituted as the part of the vacuum container is provided to the exterior of the vacuum container. The movable means, a movable means controlling circuit controlling the movable means, and abnormality detection means of the image formation apparatus, which sends a control signal to the movable means controlling circuit are provided. As a driving method, the present invention provides a driving method in which a distance of the connection is changed by sending a control signal to the movable portion from the movable means based on an output signal of the abnormality detection means. The present invention provides a constitution, and a manufacturing method, in which the elastic spring member is displaced by the vacuum force, and a manufacturing method.

[0021] A bump structure is provided to the connection portion between the wiring extended from the image formation member and the elastic body or the high voltage introduction terminal.

[0022] As described above, in order to stably supply the high voltage supplied from the high voltage introduction terminal in the vacuum container to the image formation member, it is made possible to create a situation that the connection structure can be connected stably for a long term even at a high temperature during manufacturing.

[0023]

[Embodiments] In embodiments described in detail below, an example using the following constitution will be described specifically by referring to drawings. In an image formation apparatus, errors in assembling panels in the thickness direction of the panels and errors in spacing of a hermetically sealed high voltage terminal portion are absorbed to some degrees by use of an elastic body as connection means of an external terminal, and means for generating magnetic force, which is capable of stably operating without deterioration even at a high temperature, is provided as a connection auxiliary means.

[0024] First, explanation for each of the drawings will be given. Fig. 1 is a partially cutaway schematic view showing a cross-sectional structure of a high voltage introduction portion which shows an example of a constitution of an image formation apparatus of the present invention.

[0025] In Fig. 1, a reference numeral 1 denotes a rear plate serving also as a board for forming a electron source; and a reference numeral 2 denotes an electron source region in which a plurality of electron emission elements such as field emission elements and surface conduction

type electron emission elements are arranged, and in which wirings connected to the electron emission elements so as to be capable of driving depending on purposes. The electron source region is extended to the outside of the image formation apparatus by a wiring for driving the electron source (not shown), and connected to a driving circuit of the electron source (not shown). A reference numeral 11 denotes a face plate in which an image formation member is formed; a reference numeral 12 denotes the image formation member made of fluorescent phosphor which emit light by electrons emitted from the electron source region 2; a reference numeral 100 denotes an extension wiring made of such as Ag extended to supply a voltage to the image formation member 12; and a reference numeral 4 denotes a supporting frame put and held between the rear plate 1 and the face plate 11. The wiring for driving the electron source (not shown) is buried in a low melting point glass (fritted glass), which is a sealer, in a adhered portion of the supporting frame 4 and the rear plate 1. This wiring is extended to the outside. As materials for the rear plate 1, the face plate 11 and the supporting frame 4, various materials including blue sheet glass, blue sheet glass whose surface is formed of a $SiO_2$ film, glass which has the lessened Na content, quartz glass and ceramic are used depending on conditions.

[0026] In Fig. 1, a reference numeral 101 denotes an introduction terminal for introducing a voltage supplied from a high voltage power supply of the outside; and a reference numeral 102 denotes a terminal holding member which is built in the center of a columnar shape by applying a hermetically sealing treatment to the introduction terminal 101 by use of a brazing material such as Ag-Cu and Au-Ni in advance. As a material of the terminal holding member 102, a material including ceramic and glass low in the

Na content, which has a thermal expansion coefficient approximate to that of the rear plate 1, should be used. Such a structure makes it possible to prevent cracks at the adhered portion of the terminal holding member 102 and the rear plate 1 due to the difference in thermal expansion coefficient that would otherwise occur when a temperature is high. A reference numeral 103 denotes a terminal introduction hole for introducing the terminal holding material 102 hermetically integrated with the introducing terminal 101; a reference numeral 104 denotes a mount which serves for disposing a space adjustment mechanism, and which is fixed in advance to the introducing terminal 101 made of a conductive material such as Al and SUS by laser adhering; a reference numeral 105 denotes an elastic body having a cantilever beam structure formed by performing in advance etching working for a thin plate material by use of heat resistant material such as SUS (stainless steel) and inconel; a reference numeral 106 denotes a tip member by incorporating magnetic material such as samarium-cobalt (Sm-Co) and neodymium (Nd-Fe-B) into the inside of a spherical or a hemispherical structure made of a conductive material such as Al and SUS and then by adhering them by use of a laser; and a reference numeral 107 denotes a spacer made of a conductive material such as Al and SUS, which creates an interval between the mount 104 and the elastic body 105, and which is put and held between the mount 104 and the elastic body 105 and is fixed by a laser.

[0027] Herein, the introduction terminal 101, the mounting 104, the elastic body 105, the tip member 106 and the spacer 107 are made of conductive materials, and electrically form a series circuit constitution. A reference numeral 108 denotes a magnetic member made of a magnetic material such as ferrite, samarium-cobalt (Sm-Co) and

neodymium (Nd-Fe-B), which provides a repulsive force to the magnetic body in the tip member 106. Though the magnetic body is incorporated in the tip member 106 in this embodiment, the tip material itself may be a magnetic material, and the magnetic body may be formed in the elastic body 105. Although there is no limitation in disposition locations and constitutions of the magnetic body and/or magnet, for a location of the magnetic body and/or magnet, a location should preferably be selected where the displacement amount of the movable part of the elastic member is large. For example, in the case of a cantilever spring, they are preferably located in the free end of the tip.

[0028]

Also, for the elastic boy, cantilever springs, coiled springs, springs with both ends supported, and the like, can be used. This invention relates to a slim-type image formation apparatus. In order to form a spring structure inside a narrow structure, a cantilever spring is easy to manufacture and possesses a good processing reliability, and offers a preferred embodiment. Moreover, when the cantilever spring is used, the free end should be preferably provided with a hemi-spherical or spherical tip member in consideration of capability of be in contact with the extended wiring.

[0029] Further, the focus of the present invention is to ensure that the materials do not change even if it is exposed to a high temperature, to provide a structure that offers a stable connection over a long period of time, and to provide a force for the tip member 106 to connect constantly with the extension wiring 106 by the elastic force and magnetic force by means

of a constitution incorporating the magnetic boy used in the present embodiment.

[0030] Further, although both the tip member 106 and the extension wiring 100 uses the elastic force and the magnetic force as a connection means in the present embodiment, other means are disclosed such as means which has the elastic force and the restoring function of material itself such as shape memory alloy; a means in which, after covering the tip member 106 with a high-resistance material to form a vacuum container, an electric current is supplied to the series circuit including the introduction terminal 101, the spacer 107, the elastic boy 105, the tip member 106 and the extension wiring 100 to cause the high resistance material to go through their material fusion and insulation breakdown by Joule heat and electron avalanche so that the extension wiring and the tip member 106 are securely connected; a means to achieve connection by high density energy light; a means in which the connection is adjustable from outside the vacuum container; and a means in which the adjusting means is implemented with adding safety functions such as an abnormality detection means.

[0031] For the high density energy light to heat the connection portion, an He-Ne laser, or an excimer laser, for example, may be used.

[0032] For the abnormality detection means, a transducer may be used that transduces physical values into electrical signals with such sensors as a strain gauge, a thermistor, piezoelectric control acceleration sensor, etc. A variety of

these sensors may be installed.

[0033] Types of the electron emitting element that constitutes the electron source used in the present invention are not limited to any specific types as long as the electron emission characteristics and the properties of the element such as the size, etc. are suited for the intended image formation apparatus. Cold cathode elements such as a thermal electron emission element, a field emission element, a semi-conductor electron emission element, an MIN type electron emission element, a surface conduction type electron emission element, etc. can be used. While the surface conduction type electron emission element, which will be disclosed in an embodiment described below, is preferably used for the present invention, it is the same as that which is disclosed in Japanese Patent Laid-Open No. Hei 7-235255 applied for by the same applicant as the afore-said present applicant.

[0034] The present invention will be described hereunder more in detail based on embodiments.

[0035] [Embodiment 1] A specific description will be given with reference to drawings. First, each of the drawings will be described. Fig. 1 is a partially cutaway schematic view showing a cross-sectional structure of a high voltage introduction portion which shows an example of a constitution of an image formation apparatus of the present invention. Fig. 2 is a cross-sectional diagram showing the introduction terminal at its connection structure with the extension wiring. Fig. 3 is a cross-sectional process diagram showing the process of manufacturing the introduction terminal and the tip structure.

[0036] In the drawings, a reference numeral 1 denotes a rear plate formed of blue sheet glass material having an electron source, and a reference numeral 2 denotes an electron source region in which surface conduction type electron emission elements, disclosed in Japanese Patent Laid-Open No. Hei 7-235255, are arranged in a matrix, and which are extended out of the image formation apparatus and connected with the electron source driving circuit (not shown) by means of flexible wiring for the electron driving source. A reference numeral 11 denotes a face plate in which an image formation member is formed of blue sheet glass material including a fluorescent phosphor; a reference numeral 12 denotes the fluorescent phosphor; a reference numeral 100 denotes an extension wiring made by being printed with Ag material; and a reference numeral 4 denotes a supporting frame put and held between the rear plate 1 and the face plate 11. The wiring for driving the electron source (not shown) is buried in fritted glass LS3081 made by Nippon Electric Glass Co., Ltd. in an adhered portion of the supporting frame 4 and the rear plate 1. This wiring is extended to the outside.

[0037] Moreover, a reference numeral 101 denotes the introduction terminal made of the 426 alloy material; a reference numeral 102 denotes the terminal holding material made of alumina-ceramic which has the introduction terminal 101 brazed in advance with Ag-Cu, and which, after going through a vacuum-tight sealing processing, is integrally formed in the center of a columnar shape; a reference numeral 103 denotes the terminal introduction hole, having a diameter of 10 mm, through which the terminal holding material 102 that is formed integrally and hermetically by the introduction terminal 101

is introduced; a reference numeral 104 denotes a columnar mount, having a diameter of 9.4 mm and a thickness of 5 mm, fixed with a helium neon laser welder to the tip of the introduction terminal 101 made of Al material; a reference numeral 105 denotes a cantilever spring which is obtained by making an SUS plate having a thickness of 0.1 mm into the size of 2.5 mm in length and 0.9 mm in width by etching processing; a reference numeral 106 denotes a tip member made of Al material which is machine processed to have a semi-spherical shape with 1 mm in height and 0.9 mm in diameter, and which has a hollow part in which a magnetic member can be placed therein; a reference numeral 107 denotes an Al spacer having a diameter of 0.9 mm and a height of 0.5 mm; a reference numeral 108 denotes a magnetic body A formed of samarium-cobalt (Sm-Co) magnetic material; and a reference numeral 201 denotes a magnetic body B made of samarium-cobalt (Sm-Co) magnetic material. The magnetic body 201 is processed and formed so that it is placed in the hollow part of the tip member 106, and the magnetic body A 108 is formed on the mount 104.

[0038] In this constitution, the cantilever spring 105 maintains, as shown in Fig. 3 (1), the deformation in the direction of lengthening the interval between the cantilever spring 105 and the mount 104 by disposing in a way that a repulsive force is caused by the magnetic force of the magnetic body A 108 and the magnetic body B 201.

[0039] The process of connecting the vacuum-tight introduction terminal, comprising a connection member having such a constitution, to the extension wiring 100 is described with reference to Fig. 3. Fig 3 (1) shows the process of inserting, from an insertion hole 103 formed in

the rear plate 1, a constituent member integrating the introduction terminal and the connecting member in which the terminal holding material 102 of alumina ceramic unitarily formed in the center of the columnar shape by brazing the introduction terminal 101 in advance with Ag-Cu and applying the vacuum-tight sealing treatment to the introduction terminal is connected in advance with the cantilever spring 105, the spacer 107, the tip member 106, the magnetic body A 108 and the magnetic body B 201 respectively with a helium ion (He-Ne) laser welder at the predetermined position as shown in the drawing.

[0040] Also, as shown in Fig. 3 (2), in order to form a vacuum container, a vacuum -tight sealing process is applied to the space among the top and bottom of the frame 4, the inner rim of the insertion hole 103 and the terminal holding material 104 with fritted glass 301 made of LS3081 having a thermal expansion coefficient nearly equal to that of the rear plate and manufactured by Nippon Electric Glass Co., Ltd.

[0041] While fabricating the vacuum container, in Fig. 3 (1), the interval, between the face plate 11 and the rear plate 1, determined by the support frame 4 and the fritted glass 301 is adjusted so that the interval between the cantilever spring 105 and the mount 104 is shortened from the state of being deformed in the direction of lengthening the interval. Prepared status diagrams are given in Fig. 2 and Fig. 3 (2). In this state, because a magnetic repulsive force is always acting on the magnetic body A 108 and the magnetic body B 201, the tip member 106 is pressed against the extension wiring 100.

[0042] It was verified that the vacuum container fabricated by using the means for connecting the introduction terminal as described above was able to be electrically connected and fixed to the interior of the

housing having a driving circuit substrate and a high voltage power source, not shown in the drawings, and accordingly, a stable output of a desired image was able to be made by applying a high voltage of 10 kV to the introduction terminal 101 to supply a driving voltage to the electron source formed in the electron source region 2.

[0043] Moreover, it was verified that the stable connection was maintained even when there were vibrations while transporting after the fabrication of the vacuum container, or vibrations while transporting the housing. Further, it was verified that the stable connection was made by performing a test in which the housing was given vibrations.

[0044] In this embodiment, it is made possible to manufacture the image formation apparatus which can maintain the stable connection over a long period of time even though going through a high temperature in the course of the fabrication of the vacuum container, which do not bring about a reduction in yield, and which has a high reliability.

[0045] [Embodiment 2] In the embodiment 2, an example of having a magnetic body at a location other than those which are disclosed in the embodiment 1 will be explained.

[0046] In Fig. 4, an example of forming the connection structure in which a magnet is formed to cover the cantilever 105 is explained. In the drawing, a reference numeral 401 denotes a thin film magnetic body which is fabricated by coating the cantilever spring 105 with ferrite, which is a thin film magnetic material, by an electrodeposition method. The structure, except for the thin film magnetic body 401, is the same as that which is disclosed in the embodiment 1, and the connection is achieved by means of a magnetic repulsive force. Note that various other methods such as an evaporation method, a coating method may be used in

addition to the electrodeposition method.

[0047] By this constitution, an embodiment can be given which provides the same effects as the embodiment 1 does, and which, at the same time, reinforces the connection between the tip member 106 at the tip of the cantilever spring 105 and the extension wiring 100 with enhanced resistance against changes in temperature as well as changes in physical conditions, by supplying a high voltage from the introduction terminal 101, by the thin film magnetic body 401, by a repulsive force of the magnetic body B 201 and the magnetic body A 108, and which suggests that the fabrication having a general application can be made in a place where a magnetic material is formed without being limited to the embodiment 1.

[0048] [Embodiment 3] The embodiment 3 will be explained with reference to Fig. 5. In the embodiment 3, an example of forming a magnetic body at a place other than that which is shown in the embodiment 1 and the embodiment 2 will be explained. In Fig. 5, a reference numeral 501 denotes a magnetic body A which is obtained by forming samarium-cobalt magnetic material into a columnar shape having the height of 1 mm and the diameter of 1 mm, and a reference numeral 502 denotes a magnetic material B made of samarium-cobalt magnetic material which is coated in advance on the extension wiring 100 by the coating method. According to the structure of the present embodiment 3, as shown in Fig. 6, a cantilever spring member can be replaced with a coil spring 601.

[0049] By this constitution, an embodiment is given which provides the same effects as the embodiments 1 and 2 do, and which, at the same time, the fabrication having a general application can be made without limiting the location of forming the magnetic material and the constituent member

of the elastic spring member to the embodiment 1 and the embodiment 2.

[0050] In Fig. 5, a high voltage from the introduction terminal 101 is supplied, sequentially through the mount 104, the Al spacer 106, the cantilever spring 105 and the magnetic body A 501, to the magnetic body B 502 and the extension wiring 100. The extension wiring 100 is thus supplied with the high voltage through respective conductive materials to accelerate electrons from the electron emission element in the rear plate 1, and to cause the fluorescent phosphor 12 to emit light to form an image.

[0051] Further, as is the case with Fig. 6, a high voltage from the introduction terminal 101 is supplied, sequentially through the coil spring 601 and the magnetic body A 501, to the magnetic body B 502 and the extension wiring 100 to supply a stable high voltage to the extension wiring 100 against the temperature increase and environmental changes while connecting the rear plate 1, the support frame 4 and the face plate 11.

[0052] [Embodiment 4] The embodiment 4 will be explained with reference to Fig. 7. In the embodiment 4, an example is disclosed which has an Au bump on the tip member 106, by a known bump forming method, between the extension wiring and the tip member. The constitution, except for the AU bump 701, is the same as that of the embodiment 1.

[0053] In Fig. 7, a high voltage from the introduction terminal 101 is supplied, sequentially through the mount 104, the Al spacer 107, the cantilever spring 105, the tip member 106 and the Au bump 701, to the extension wiring 100. The extension wiring 100 is thus supplied with the high voltage to accelerate electrons from the electron emission element in the rear plate 1, and to cause the fluorescent phosphor 12

to emit light to form an image. In this instance, the cantilever spring 105 is pulled upward in the drawing by a magnetic repulsive force of the magnetic material A 108 and the magnetic material B 201 to cause a tight connection between the Au bump 701 and the extension wiring 100.

[0054] According to this constitution, since the localized force is concentrated on one point in the connection portion with the extension wiring 100 made of an Ag material because of the pressing forces caused by magnetic force and the elastic spring 105 as well as the constitution and structure of the needle portion of the Au bump, it is made possible to further increase the reliability of the connection.

[0055] [Embodiment 5] The embodiment 5 will be explained with reference to Fig. 8 and Fig. 9. In the example shown in Fig. 8, a magnetized member 802 made of magnetizable chrome iron material is used inside the tip member 106 in the interior of a vacuum container. Further, outside the vacuum container, a samarium-cobalt magnetic body 801, which is a material for a magnet, is arranged. Other aspects of the constitution are similar to those of the embodiment 1.

[0056] In Fig. 8, a high voltage, from the introduction terminal 101, for introducing a high voltage is supplied sequentially through the mount 104, the Al spacer 107, the cantilever spring 105 and the tip member 106, to the extension wiring 100. The extension wiring is thus supplied with the high voltage to accelerate electrons from the electron emission element in the rear plate 1, and to cause the fluorescent phosphor 12 to emit light to form an image. In this instance, by magnetic attraction forces of the magnetic body 802 and the samarium-cobalt magnetic body 801, the cantilever spring 105 is pulled upward in the drawing to cause a tight connection between the tip member 106 and the extension wiring

100.

[0057] In Fig. 9, diagrams showing characteristics of this constitution are given. Fig. 9 (A) is a status diagram showing that the properties of the spring have changed while baking a vacuum container, and the connection portion is separated between the tip member 106 and the extension wiring 100. By placing the magnetic body 801 after forming the vacuum container, the tip member 106 takes a constitution where it is pressed against the extension wiring 100 as shown in Fig. 9 (b). Note that when connecting the tip member 106 and the extension wiring 100, the position of the magnetic body 108 placed outside the vacuum container is not limited only to the side of the face plate 11, but may be on the rear plate side. There is no limitation on the installation position.

[0058] According to this constitution, since a suitable magnetic material may be selected depending on the degree of deterioration of the properties of the spring, the quality control of the properties of the spring characteristics may be loosened, whereby enabling quality control costs to be reduced.

[0059] Further, regarding the respective connection methods described in afore-said embodiments 1 through 4, particularly in case that the connection between the magnetic body B 201 and the extension wiring 100 is inadequate, the connection can be maintained stably and surely by placing the samarium-cobalt magnetic body 801 outside the vacuum container.

[0060] [Embodiment 6] The embodiment 6 will be explained with reference to Fig. 10. Although status diagrams are given which illustrate the case that a tip member is separated as shown in Fig. 9 (A) about the embodiment 5, FIG.10 shows an example

that can maintain a stable connection without being separated even if the magnetic body 801 is removed after connecting the tip member 106 to the extension wiring 100 by means of the magnetic body 801.

[0061] A coating material 1001 is formed on the surface of the tip member 106 by the electrodeposition method with Au. As shown in Fig. 10 (A), the tip member 106 having the coating material 1001 is connected to the extension wiring 100 by means of the magnetic body 801. Under this condition, He-Ne laser light is irradiated to the spot where the coating material 1001 on the tip member 106 is in contact with the extension wiring 100 to fuse Ag that is the material for the extension wiring 100 and Au that is the coating material 1001 to fasten the materials together. Since the blue sheet glass material is used for the face plate 11, and rear plate 1 and the frame 4, the laser light passes through the blue sheet glass. Note that although an example of irradiating from a position of the frame 4 is given in the present embodiment, there is no limitation on the irradiation position.

[0062] For example, the irradiation may be performed from the side of rear plate 1. The status after performing the fusion connection and removing the magnetic body 801 from the status shown in Fig. 10 (A) is given in Fig.10(B). As shown in this diagram, since the coating material 1001 on the tip member 106 and the extension wiring 100 is under the condition of metallic connection, a stable connection can be maintained over a long period of time even if the magnetic material 801 is removed.

[0063] Note that, although the connection is performed by laser irradiation in the present embodiment 6, other methods may be performed such as selecting a high resistance material for the coating material, and applying a high voltage from the introduction terminal in the course of the manufacturing process to cause Joule heat and insulation breakdown to achieve a fusion. Thus, the method is not limited to laser irradiation.

[0064] In Fig. 10, a high voltage, from the introduction terminal 101, for introducing a high voltage is supplied, sequentially through the mount 104, the Al spacer 107, the cantilever spring 105, the tip member 106 and the coating material 1001, to the extension wiring 100. The extension wiring 100 is thus supplied with a high voltage to accelerate electrons from the electron emission element in the rear plate 1, and to cause the fluorescent phosphor 12 to emit light to form an image. In this instance, since the coating material 1001 and the extension wiring 100 are fused together, the connection resistance value is minimized. An efficient power supply can be made without a reduction in high voltage.

[0065] In this constitution, since the magnetic material is required only while manufacturing an image formation apparatus, the configuration of members of the image formation apparatus can be simplified, resulting in a cost reduction.

[0066] [Embodiment 7] The embodiment 7 will be explained with reference to Fig. 11. As illustrated in Fig.11, an example of a constitution taken when an electromagnet 1101 is disposed outside the vacuum container is shown. A reference numeral

1103 denotes the electromagnetic force generating/controlling circuit, and 1102 denotes a panel abnormality detection means. The electromagnetic force generating/controlling circuit 1103 feeds back information from the panel abnormality detection means 1102, and controls the magnetic force of the electromagnet 1101 in response to the fed back information. Other aspects of the constitution are the same as those of the embodiment 5.

[0067] In Fig.11 (A) showing the normal condition, a high voltage, from the introduction terminal 101, for introducing a high voltage is supplied, sequentially through the mount 104, the Al spacer 106, the cantilever spring 105 and the tip member 106, to the extension wiring 100. The extension wiring is thus supplied with the high voltage to accelerate electrons from the electron emission element in the rear plate 1,and to cause the fluorescent phosphor 12 to emit light to form an image. In this instance, since the tip member 106 and the extension wiring 100 operate the electromagnet 1101 by the electromagnetic force generating/controlling circuit 1103 to establish the connection, a high voltage is supplied stably and surely.

[0068] That is, when there is no abnormality in the panel, as shown in Fig. 11 (A), the electromagnetic force generating/controlling circuit 1103 controls the electromagnet 1101 to generate an attraction force with the magnetized body 802 to cause the tip member 106 to be connected with the extension wiring 100.

[0069] However, for example, when there is an anomaly in the panel due to electrical discharge, etc. to cause the panel temperature to rise and exceed the predetermined standard over which the panel may be damaged

by thermal stress, the panel abnormality detection means 1102 detects and sends such information to the electromagnetic force generating/controlling circuit 1103, which causes the tip member 106 to separate from the extension wiring 100 by controlling the electromagnetic force so as to disrupt the generation of magnetic field or apply a repulsive force. (Fig. 11 (B))

[0070] Note that, for the panel abnormality detection means 1102, temperature detection means such as thermistor for detecting the temperature of the face panel 11 may be used. Alternatively, a vacuum pressure measuring means in a pressure gauge, to detect the degree of internal vacuum, set up inside the vacuum container may be used. Still alternatively, an electrical current measurement means having a low resistance placed in the introduction terminal 101 may be used.

[0071] As a result, since the face plate 11 is not supplied with a high voltage, the temperature increase on the side of the face plate 11 is suppressed so as to prevent the panel from being damaged.

[0072] [Embodiment 8] The embodiment 8 will be explained with reference to Fig. 12. A thin metallic plate A 1201 and a thin metallic plate B 1202 are two kinds of metallic plates having different thermal expansion coefficients, and are fused into a single plate by laser fusion. A copper material is used for fabrication of the thin metallic plate A 1201, and an invar material for the thin metallic plate B 1202. In this constitution, the direction and force of the connection can

be controlled by temperature. When the temperature rises, the tip member 106 moves from the status shown in Fig. 12 (A) to the status shown Fig. 12 (B), that is, moves away from the extension wiring 100.

[0073] In Fig. 12 (A) which shows the normal condition, a high voltage, from the introduction terminal 101, for introducing a high voltage is supplied, sequentially through the mount 104, the Al spacer 106, the thin metallic plate A 1201, the thin metallic plate B 1202 and the tip member 106, to the extension wiring 100. The extension wiring is thus supplied with a high voltage to accelerate electrons from the electron emission element in the rear plate 1, and to cause the fluorescent phosphor 12 to emit light to form an image. In this instance, since the thin metallic plate A 1201 and the thin metallic plate B 1202 have properties like a bimetal, as long as the temperature inside the vacuum container remains steady, the tip of the thin metallic plate A 1201 and the thin metallic plate B 1202 is twisted upward because the degree of contraction of the thin plate A 1201 is larger than that of the thin plate B 1202. As a result, the tip member 106 and the extension wiring 100 are connected to supply a high voltage stably and surely.

[0074] By taking this constitution, as in the case of the embodiment 7, for example, when a temperature rises on the side of the face plate 11 due to a panel abnormality, the heat is conducted through a tip connection member to cause the connection portion to separate by a bimetallic effect. Thus, a panel damage can be avoided.

[0075] [Embodiment 9] The present embodiment 9 discloses a constitution that enables the connection by means other than a magnet means. The embodiment 9 will be explained with reference to Fig. 13, Fig. 14 and Fig. 15. Fig. 13 is a perspective diagram of the vacuum container external connection mechanism for the high voltage introduction terminal, and is a view from the side of the rear plate 1 of the vacuum container disposed on the side of the rear plate 1. Fig.14 is an exploded, perspective view to break down and explain the vacuum container external connection mechanism for connecting the introduction terminal 101 through the tip member 106 to the extension wiring 100 formed in the face plate 11. Fig.15 is a partially cutaway, cross sectional process diagram viewed from the direction of arrow A in Fig. 13 for explaining the connection process using the vacuum container external connection mechanism.

[0076] In Fig. 13, a reference numeral 1301 denotes a unitary spring component using a hollowed 462 alloy material and having an integrally formed spring which has a concentric spring part movable in the direction of the Y-axis as shown in the diagram and a spring movable section. A reference numeral 1302 denotes a hollow member made of 426 alloy material which has a female screw thread section in the inner circumference of the hollow member and is fastened to the unitary spring component, and 1303, a hollow screw made of stainless steel formed with male screw thread on the outer circumference of a hollow member.

[0077] The connection mechanism formed outside of the vacuum

container will be explained more in detail with reference to Fig.14 and Fig.15. The introduction terminal 101 comprises: the terminal holding material 102, made of alumina ceramic, and unitarily formed in the center of a columnar shape, by being brazed with Ag-Cu brazing in advance and by being subjected to vacuum-tight sealing treatment; the cantilever spring 105 fastened by laser fusion; and a tip member 106. The unitary spring component 1301 and the hollow member 1302 are fastened in advance by laser fusion. The unitary spring component 1301 and the hollow member 1302 so fastened as well as the terminal holding material 102 and the unitary spring component 1301 are hermetically sealed with fritted material, not shown, as described in regard to the embodiment 1, at the time of forming the vacuum container.

[0078] After forming this vacuum container, the hollow screw 1303 is inserted into the hollow member 1302. The condition in which various members are formed is shown in Fig. 15 (A). Under this condition, the tip member 106 and the extension wiring 100 are separated. After this, as shown in Fig. 15 (A) and Fig. 15 (B), it is rotated with a rotation jig 1402 for the hollow screw 1303 by making use of an opening 1401 formed in the hollow screw 1303. By this, a force to press the movable section of the spring of the unitary spring component 1301 with a protrusion formed at the tip portion of the hollow screw 1303 in the direction of Z in the drawing, that is, the tip member 106 is pressed against the extension wiring 100 as the cantilever spring 105 deforms. Then, the extension wiring 100

and the tip member 106 are electrically connected, and a voltage can be supplied from an external high voltage source, not shown, to the extension wiring 100 in the vacuum container.

[0079] For the connection used in the present embodiment 9, the deformation of the unitary spring component by means of the hollow screw 1303 and the rotation jig 1402 is used, but there is no restriction on means for causing the spring to deform.

[0080] As shown in Fig. 16 (A) and Fig. 16 (B), it is made possible to take a constitution in which, considering the balance between the vacuum force and the spring force of the unitary spring component 1301, the interior of the vacuum container comprising the rear plate 1, the face plate 11 and the frame 4 is exhausted by an exhaustion means to cause the elastic spring member to deform by the vacuum force depending on the degree of interior vacuum against the outside air pressure so that the high voltage introduction terminal may directly come into contact with the extension wiring. Further, the rotation jig 1402 may be replaced with a motor to be driven. Still further, the installing of a motor, a motor control means and an abnormal detection means may serve as a safety mechanism.

[0081] In the present embodiment 9, this constitution provides same effects as that of the embodiment 1 does, and, at the same time, provides a versatile device that offers connection means to be performed from outside the vacuum container, which are configured of materials other than a magnetic one. The connection means can be chosen, when deemed necessary, in

accordance with usage conditions.

[0082] Note that, although examples of using a surface conduction type electron emission element for an electron emission element forming the electron source in the afore-mentioned embodiment, the present invention is of course not restricted to them. Semi-conductor electron emission element and other types of electron emission element may also be used for an electron source.

[0083] Further, although the rear plate of the image formation apparatus also serves as the base for the electron source in the embodiment, the base may be a member separated from the rear plate, and may be fastened to the rear plate after an electron source has been produced. Moreover, for the sake of convenience of describing the respective embodiments and constitutions, the rear plate and the electron source have been explained as a single unit. Although examples in which the introduction terminal is inserted from the side of the rear plate are given, the present connection constitution may be used for cases in which the insertion is performed from the side of the face plate.

[0084] Also in other respects, various members shown in the embodiments may be changed, when deemed necessary, within the scope of technical thoughts of the present invention.

[0085]

[Advantages of the Invention]

As described above, by taking the constitution of the present invention, a highly reliable connection method can be

implemented because the connection performance will not deteriorate even if subjected to the process at a high temperature.

[0086] Moreover, since the connection may be adjusted from outside the container after fabricating the vacuum container, image formation apparatuses can stably be fabricated without reducing the yield of the image formation apparatuses.

[0087] Further, since there is no need for quality control of constituent members of the connection portion with high precision, the quality-related cost can be reduced.

[0088] Still further, since there is an adjusting means performed from outside the container, the connection can be disconnected after once completing the connection, whereby offering a versatile connection. For example, such is effective when an abnormality is detected in the image formation apparatus, and disconnecting the connection is desired.

[Brief Description of the Drawings]

Fig.1 is a partially cutaway, perspective schematic view showing a section structure of a high voltage connection portion according to the present invention.

Fig.2 is a cross sectional, schematic view of a section structure of a high voltage connection portion showing an example of an image formation apparatus according to the present invention.

Fig.3 is a diagram for explaining a part of the process of manufacturing the image formation apparatus of Fig. 2.

Fig.4 is a diagram for explaining an embodiment 2 according to the present

invention.

Fig.5 is a diagram for explaining an embodiment 3 according to the present invention.

Fig.6 is a diagram for explaining the embodiment 3 according to the present invention.

Fig.7 is a diagram for explaining an embodiment 4 according to the present invention.

Fig.8 is a diagram for explaining an embodiment 5 according to the present invention.

Fig.9 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of Fig. 8.

Fig.10 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of an embodiment 6.

Fig.11 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of an embodiment 7.

Fig.12 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of an embodiment 8.

Fig.13 is a perspective view for explaining an embodiment 9.

Fig.14 is an exploded, perspective view of a vacuum container external connection mechanism for explaining the embodiment 9.

Fig. 15 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of the embodiment 9.

Fig. 16 is a diagram showing a part of the manufacturing process for explaining the manufacturing of the image formation apparatus of the embodiment 9.

[Description of Reference Symbols and Numerals]

1 Rear Plate

2 Electron Source Region

4 Support Frame

11 Face Plate

12 Fluorescent Phosphor

100 Extension Wiring

101 Introduction Terminal

102 Terminal Holding Material

103 Terminal Introduction Hole

104 Mount

105 Cantilever Spring

106 Tip Member

107 Spacer

108, 501 Magnetic Body A

201, 502 Magnetic Body B

401 Thin Film Magnetic Body

601 Coil Spring

701 Bump

801 Magnetic Body

1001 Coating Material

1101 Electromagnet

1102 Panel Abnormality Detection Means

1103 electromagnetic force generating/controlling circuit

1201 Metallic Thin Plate A

1202 Metallic Thin Plate B

1301 Unitary Spring Component

1303 Hollow Screw

1401 Opening

1402 Rotation Jig

Fig.1

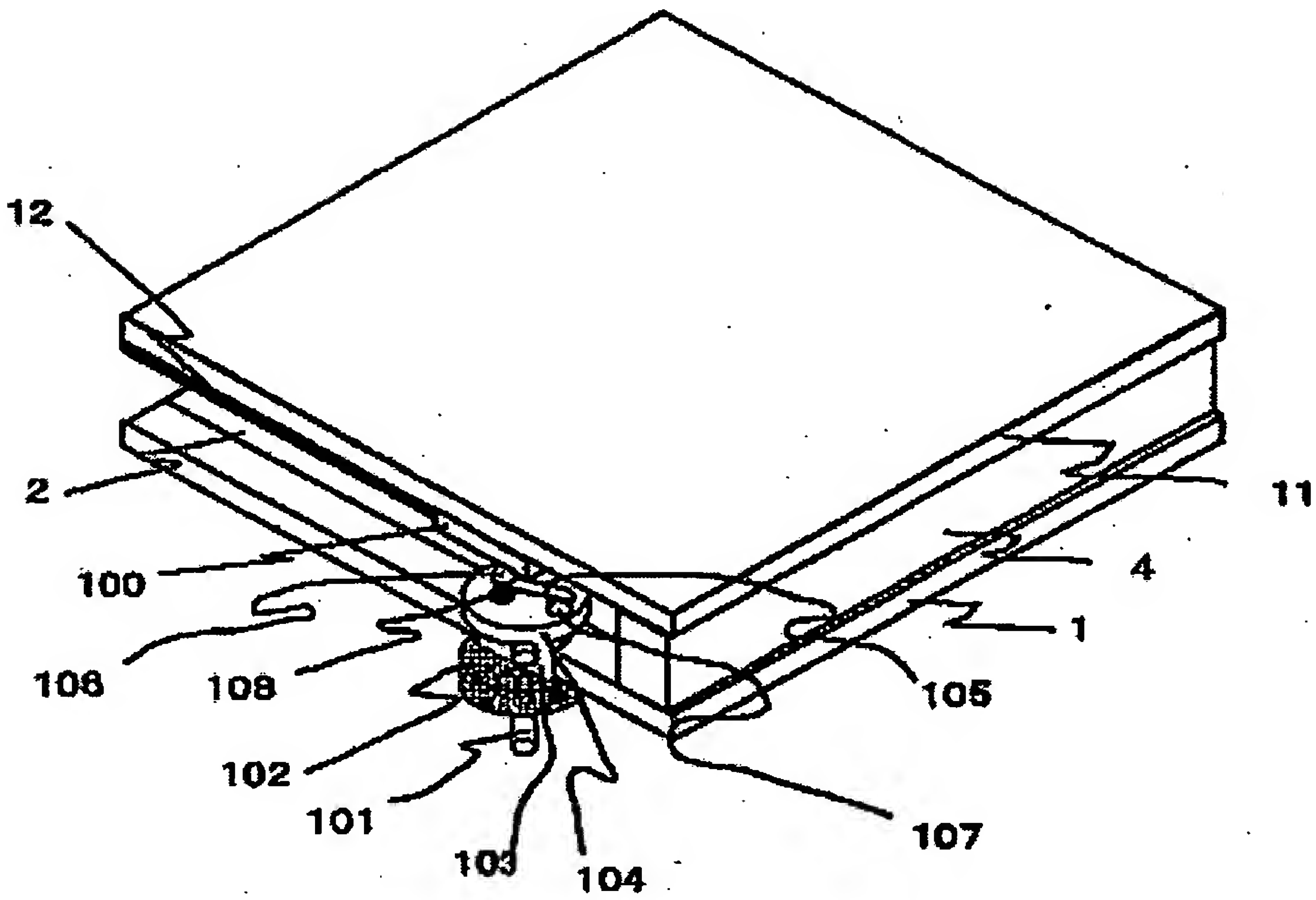



Fig.2

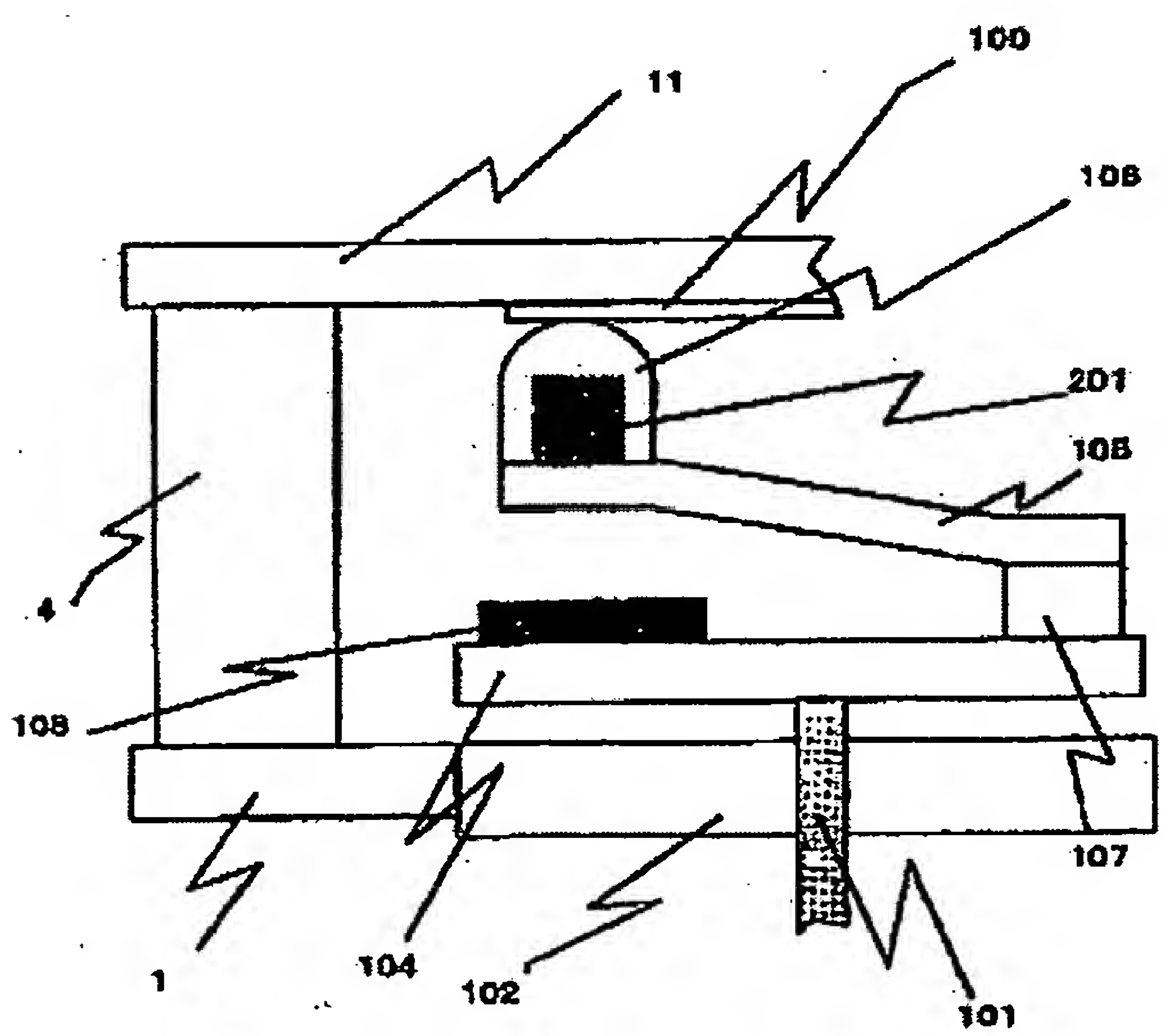



Fig.3

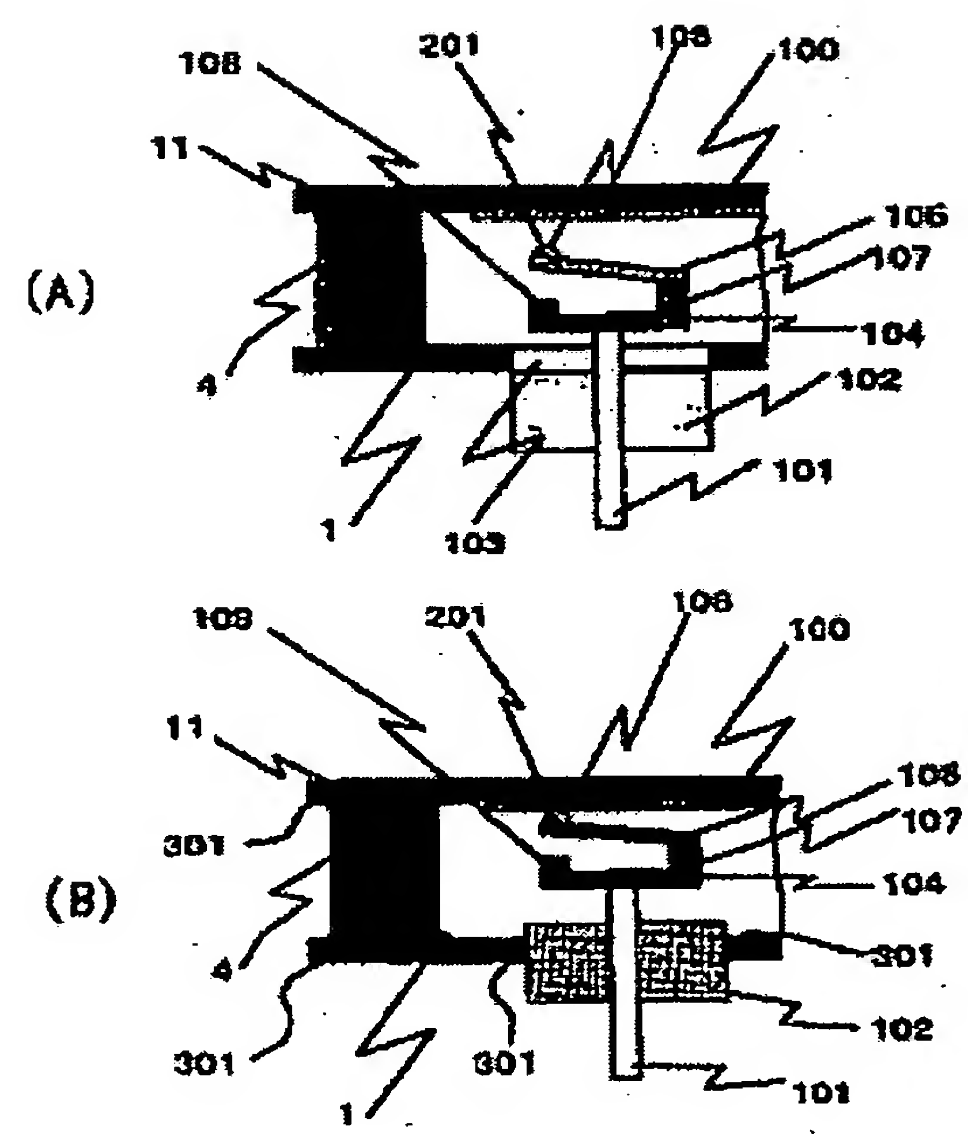


Fig.4

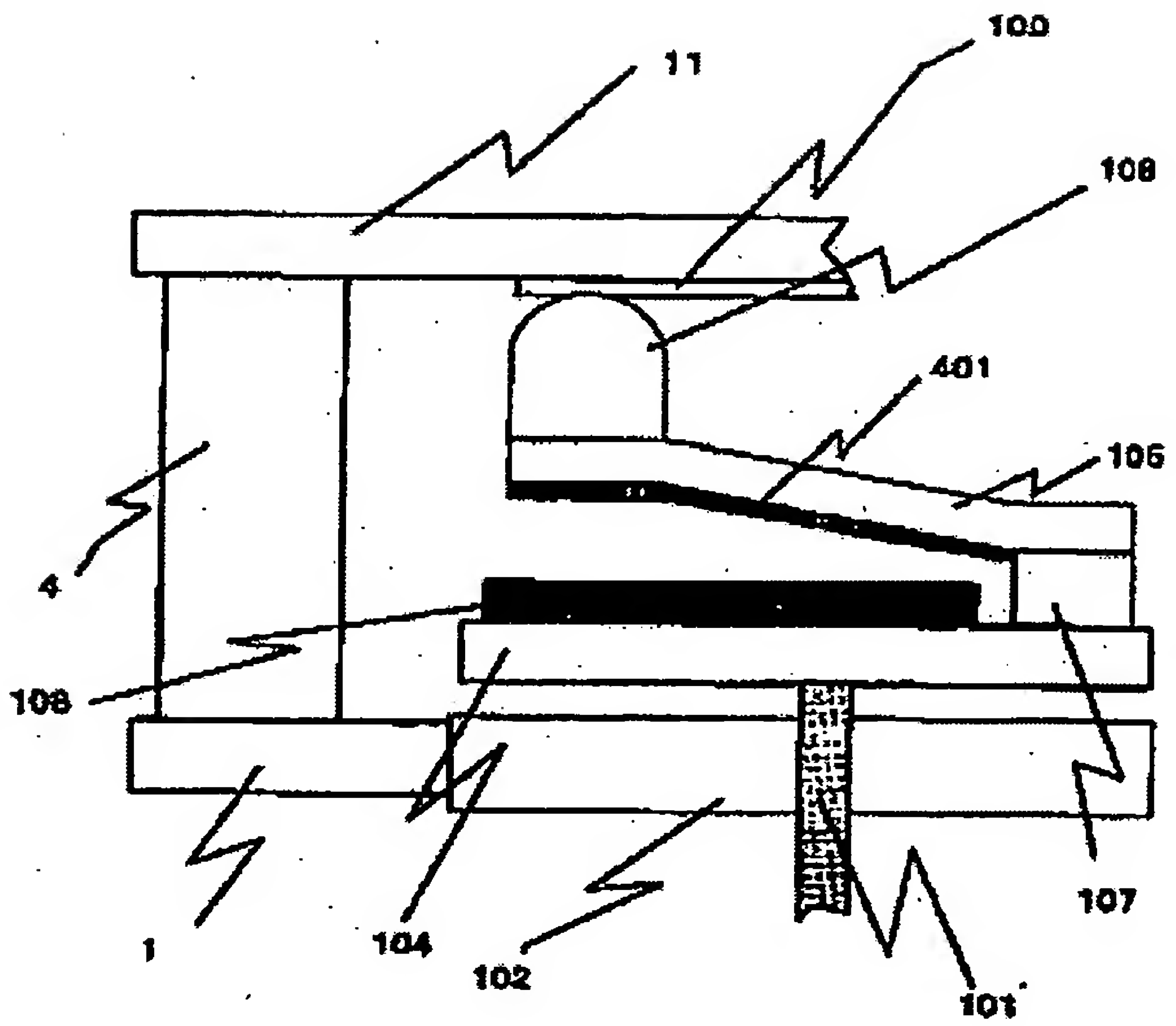



Fig.5

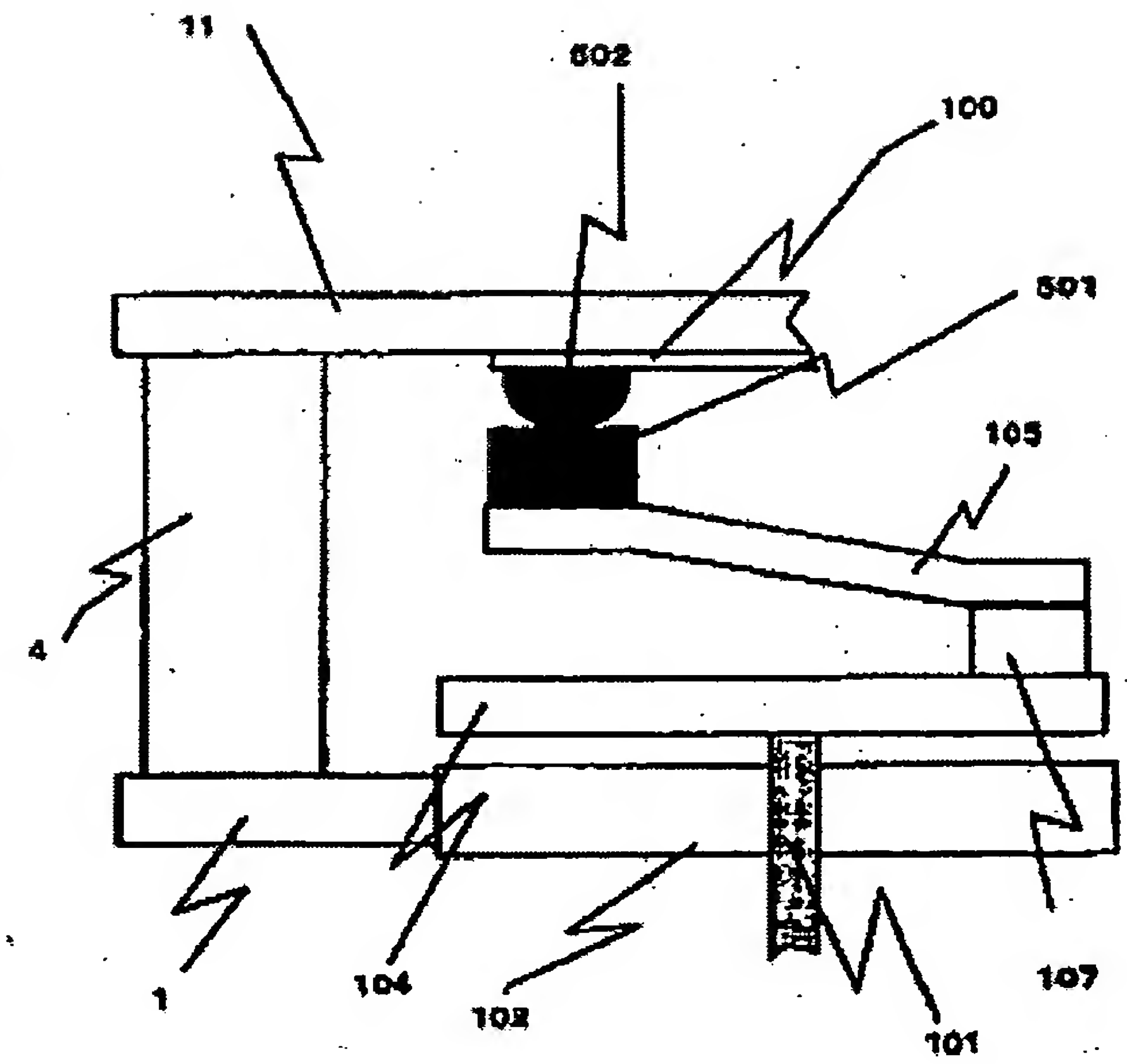



Fig.6

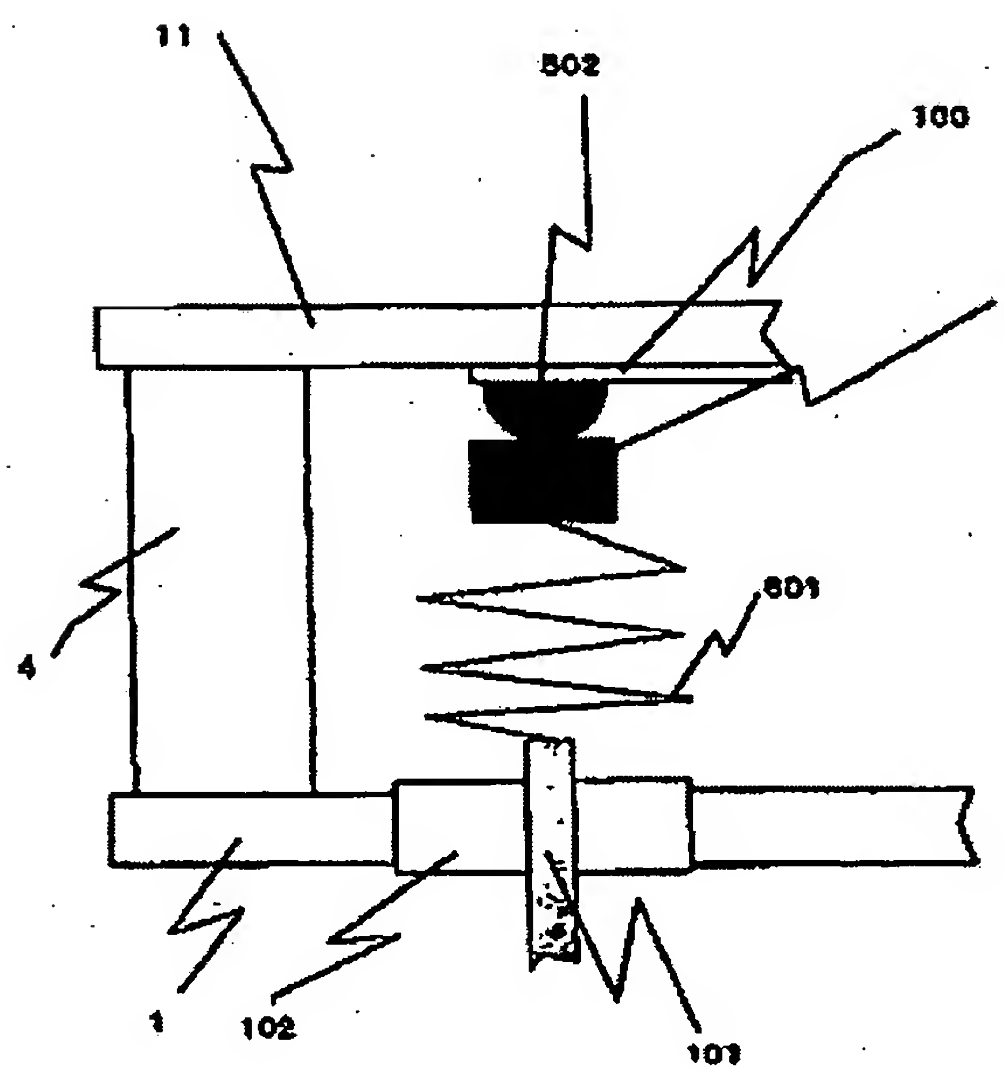
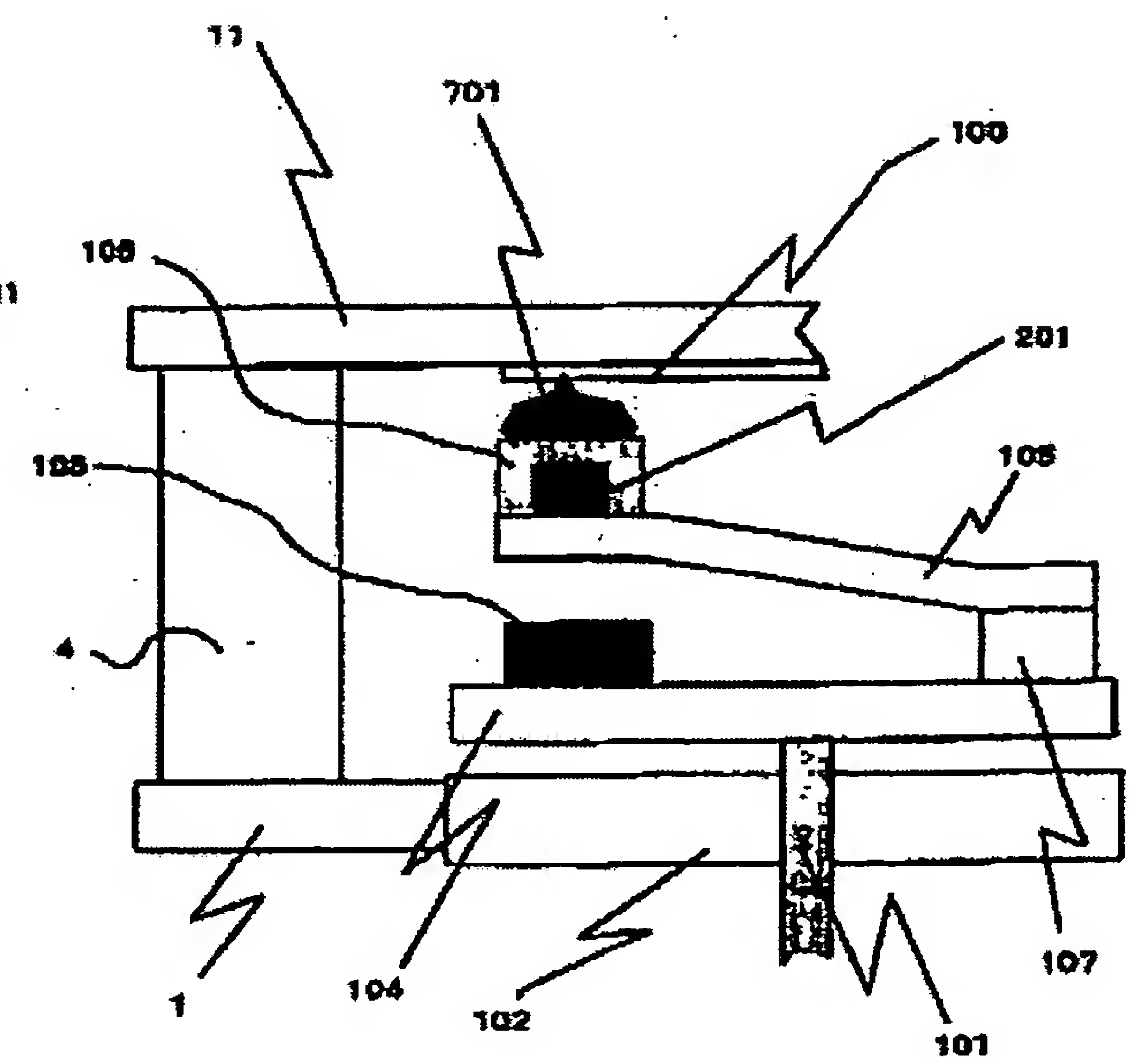



Fig.7



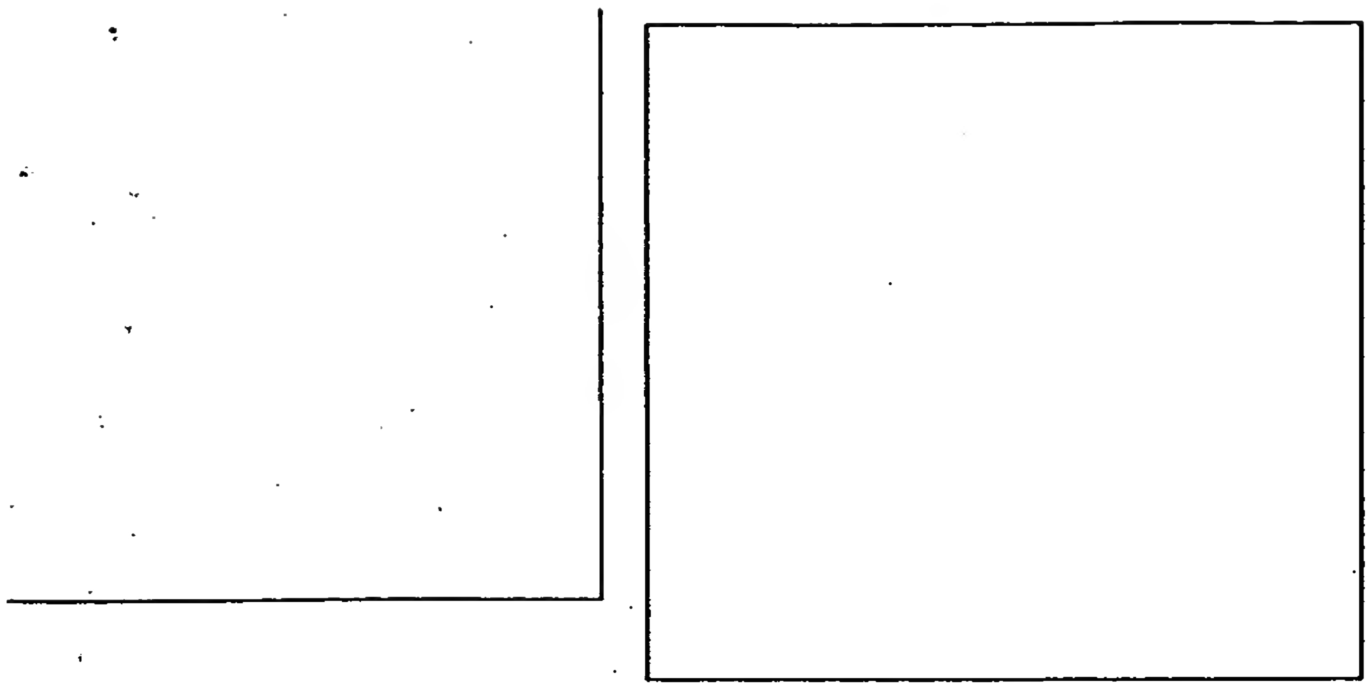
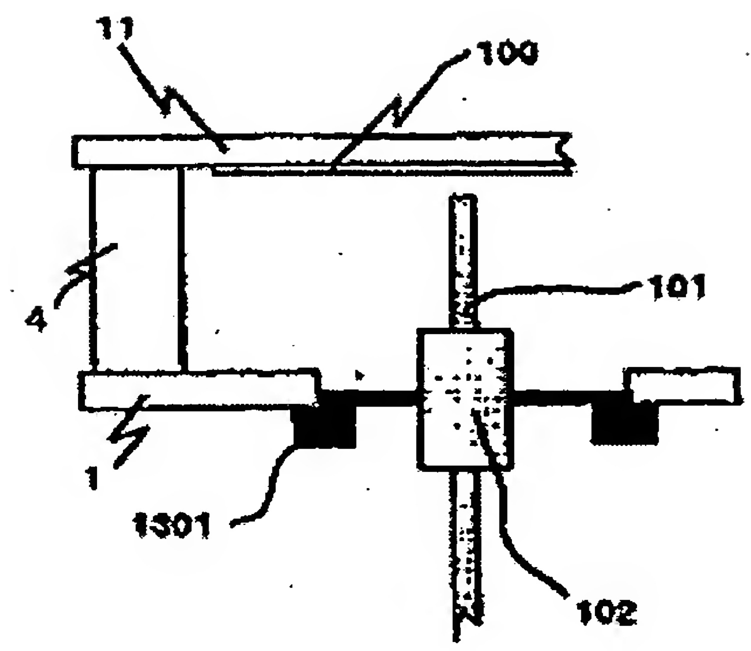


Fig.8

Fig.10

Fig.16

(A)




(B)